

Application No.: 10/747,655Docket No.: 1315-051REMARKS

Claim 1 has been amended. Claims 5-8 have been cancelled. Claims 9-17 have been added. Thus, Claims 1-4, 6, 7 and 9-17 are now active and under consideration.

Recently, it was discovered that incorporation of ultra-fine powders of TaC-based carbides in tools results in increased hardness, transverse-rupture strength and wear resistance of the tools. This requires the production of TaC-based powders which are as fine as possible.

Unfortunately, conventionally made TaC powders have a relatively coarse particle size of about 1 to 2 μm . Moreover, the conventional process for making TaC powders requires that a powder mixture of tantalum oxide and carbon be subjected to a high-temperature treatment of from 1,500 to 1,600°C in a vacuum or inert atmosphere. This conventional process is expensive due to the use of costly equipment and large power consumption.

The method of present Claims 1-4, 6, 7 and 9-14 provides a method which avoids the above disadvantages, and results in TaC powder of a much smaller size. See page 7, Table 1 of the present specification. Claims 15 and 16 are directed to a TaC-transition metal based complex powder produced by the method of claim 1, while claim 17 pertains to the product, itself.

Claims 1-8 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kim et al. (U.S. 2002/0043130A) in view of Hardy et al. (U.S. 7,488,291) and Shaw et al. (U.S. (6,214,309)).

However, none of the cited references either describes or suggests the subject matter of Claims 1-4, 6, 7 and 9-15.

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Notably, the disclosure of Kim et al. is quite different from the subject matter of present claims 1-4, 6, 7 and 9-17 as the objective of Kim et al. is the production of a WC/Co based complex carbide powder composed of W as a main component.

Importantly, Kim et al. cannot be read to describe that if the oxides of W and Co are reduced and carburized by reducing under the condition at temperature of 800°C for a duration of 24 hours, Ta might also be reduced at this temperature.

This is because the oxide of Ta is not reduced at a temperature of 800°C, irrespective of duration. As shown in attached Fig. A, according to a standard thermodynamic calculation, TaC is not reduced at a temperature of less than about 1700K (1427°C). Rather, reduction of Ta oxide occurs above a temperature of about 1700K, where the Gibbs Free Energy becomes negative.¹

As described for a conventional process at page 1 of the present specification, TaC has been conventionally reduced at a temperature range of from 1500 to 1600°C. Thus, from thermodynamic considerations, the possibility of Ta reduction at the reducing temperature of Kim et al. is negligible at best.

Furthermore, amended Claim 1 requires that a transition metal based oxide first be reduced at temperature of 600 to 1100°C firstly, and then, secondly, that Ta be reduced and carburized at a temperature of 1000 to 1350°C.

¹ The Gibbs Free Energy, (G), of a system at any point in time is defined as the enthalpy of the system (H) minus the product of the temperature (T) and entropy (S) or $G = H - TS$. A process will occur spontaneously if G is negative. See chemed.chem.purdue.edu/genchem/topicreview/bp/ch21/gibbs.html.

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When a dried Ta-transition metal complex oxide is heated at 1000 to 1350°C, for example, each oxide of Co and Ta, as transition metal based oxides, is competitively reduced, whereby, delayed reduction of Ta occurs. In fact, CO or CO₂ is generated rapidly by the reduction of both oxides, and if the amounts of such products become high, the reduction of Ta is delayed leading to increased reaction time. Increased reaction leads to reduced productivity, whereby cost increases occur. Further, as described in the present specification, the produced CO or CO₂ combines with the environment gas to generate moisture, which hinders the reduction of Ta oxide as well.

Therefore, according to the method of claims 1-4, 6, 7 and 9-13, transition metal oxide is reduced at a comparatively low temperature of 600 to 1100°C. At this temperature range, only a relatively small reduction of Ta occurs followed by the elimination of CO generated by Co oxide. Then, reduction is effected at above 1000 to 1350°C to improve productivity by preventing delay of Ta reduction.

As described above, conventionally, the following treatments have been known and used: i) under 800°C and for 24 hours, W and Co are reduced, ii) at a high temperature range of 1500 to 1600°C, Ta oxide is reduced, and iii) under at 800°C and for 24 hours, Ta, which is added in a small amount as a grain growth inhibitor, is partially reduced. However, the use of a reducing and carburizing step for a main component of Ta oxide at a temperature range within 1000 to 1350°C as is recited in amended claim 1 has not yet been known.

Meanwhile, as described in the present specification where Ta oxide is reduced at above 1500°C, a complex powder of nm unit

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scale may not be produced due to the cost increase, i.e., investment increase of equipment, increase of power cost as well as coarse-grained growth. See pages 7 and 8 of the present specification.

Additionally, Kim et al. describe the inclusion of only small amounts of tantalum as a grain inhibitor. In contrast, present claim 3 infers a tantalum content of 70-99wt%.

Clearly, one skilled in the art would be neither motivated nor enabled from Kim et al. to practice the method of present Claims 1-4, 6, 7 and 9-13. The Examiner has acknowledged as much in citing Hardy et al. and Shaw et al.

However, neither Hardy et al. nor Shaw et al. correct the deficiencies of Kim et al.

Notably, neither Hardy et al. nor Shaw et al. discloses or suggests any specified process conditions for a reducing temperature for Ta. Thus, the conditions of the second step of reduction of claim 1 are not disclosed at all. As noted already, the particular conditions of the first reduction, and then second reduction and carburization steps of present Claims 1-4, 6, 7 and 9-13 are important in order to achieve the intended result. Again, note attached Figure A, whereby the importance of the temperatures claimed in claim 1 may be appreciated. Further, pages 7 and 8 of the present specification evidence the importance of the claimed temperature ranges in claim 1.

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Clearly, one skilled in the art would be neither motivated nor enabled even from the combined teachings of the cited references to practice the subject matter of present claims 1-4, 6, 7 and 9-17.

Additionally, inasmuch as even the combined disclosures of the cited references fail to either disclose or suggest the subject matter of claims 1-4, 6, 7 and 9-14, i.e., the method; these references also fail to disclose or suggest the complex powder of claims 15-17 which is produced by the method of claim 1.

Hence, this ground of rejection is unsustainable and should be withdrawn.

Claims 1-8 stand provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-9 of copending application Serial No. 10/747,657, based upon the Examiner's view that Ta and Ti are both refractory metals.

However, "refractory metals" are defined as those metals having a melting point higher than 1,750°C. Refractory metals include Tungsten (mp 3,410°C), Tantalum (mp 2,996°C), Molybdenum (mp 2,610°C), Niobium (mp 2,468°C), Rhenium (mp 3,810°C), Indium (mp 2,454°C), Hafnium (mp 2,222°C) and Osmium (mp 3,045°C). See www.hcstarck.com. Notably, Titanium is not a "refractory element," as it has a melting point of only 1,660°C. See <http://www.chemicalelements.com>.

Clearly, titanium cannot be considered a refractory element and Examiner's premise-upon which to base the obviousness-type double patenting rejection-is demonstrably false. Thus, one skilled in the art would have no reason to view titanium and

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tantalum as interchangeable in any process. Hence, the claims of the two copending applications are directed to patentably distinct subject matter.

Hence, this ground of rejection is deemed moot.

Finally, attention is directed to the Information Disclosure Statement filed in copending application Serial No. 10/747,657, a copy of which is attached for the Examiner's convenience.

Accordingly, in view of the above, it is believed that this application now stands in condition for allowance. Early notice to this effect is earnestly solicited.

Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 07-1337 and please credit any excess fees to such deposit account.

Respectfully submitted,

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[Fig. A]

